UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

October 20, 2017

Mr. Victor M. McCree
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SAFETY EVALUATION OF THE NUSCALE POWER, LLC TOPICAL REPORT TR-0116-20825-P, "APPLICABILITY OF AREVA FUEL METHODOLOGY FOR THE NUSCALE DESIGN," REVISION 1

Dear Mr. McCree:

During the 647th meeting of the Advisory Committee on Reactor Safeguards, October 5-6, 2017, we reviewed the NRC staff's safety evaluation report (SER) for the NuScale Power, LLC (NuScale) topical report TR-0116-20825-P, Revision 1, "Applicability of AREVA Fuel Methodology for the NuScale Design." Our NuScale Subcommittee also reviewed this matter during a meeting on September 20, 2017. During these meetings, we had the benefit of discussions with the staff and representatives of NuScale. We also had the benefit of the referenced documents.

CONCLUSION and RECOMMENDATION

The AREVA methods and codes discussed in the NuScale topical report, with the noted modifications and staff-imposed limitation, are applicable for use in analyzing the NuScale fuel design. The safety evaluation report should be issued.

BACKGROUND

NuScale submitted topical report TR-0116-20825-P, Revision 1, for NRC review in July 2016. NuScale states that the following AREVA methodologies are applicable to evaluate performance of the NuScale fuel design:

- BAW-10084P-A, Revision 3, "Program to Determine In-Reactor Performance of BWFC Creep Collapse"
- BAW-10227P-A, Revision 1, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel"
- BAW-10231P-A, Revision 1, "COPERNIC Fuel Rod Design Computer Code"

- EMF-92-116 (P)(A), Revision 0, “Generic Mechanical Design Criteria for PWR Fuel Designs”
- XN-75-32 (P)(A), Supplements 1-4, “Computational Procedure for Evaluating Fuel Rod Bowing”

These AREVA methodologies have been approved for analyzing pressurized-water reactor (PWR) fuel at operating plants, and cover evaluation of cladding and structural material, fuel mechanical analysis, fuel thermal-mechanical analysis, fuel cladding creep collapse, and fuel rod bowing as applied to the fuel design. NuScale methodologies for performing neutronics analysis, safety analysis, and thermal-hydraulic analysis are not described in this topical report.

DISCUSSION

BAW-10084P-A, Revision 3

This clad creep collapse methodology with the CROV code will be used for the NuScale fuel, using the creep correlation for M5 clad rods in a PWR as cited in BAW-10227P-A. Because the NuScale fuel is shorter than standard PWR fuel, NuScale will perform a revised calculation to determine the limiting conditions that bound all axial locations for creep using fast flux and clad temperature with the COPERNIC code. The staff found this approach acceptable and conservative.

BAW-10227P-A, Revision 1

The staff noted that this topical report methodology has no restriction on the fuel type and is applicable to NuScale fuel. The staff compared the NuScale fuel design against parameters important to clad stress, fuel rod buckling, and clad fatigue analyses and confirmed they are identical in these parameters and found this methodology applicable. It is approved for M5 clad up to 62 GWd/MTU, which bounds the anticipated operation of NuScale fuel. It is important to note that the parameter range of the predictive capability of the codes and methodology are separate and do not translate into support of the operational capability of the fuel being analyzed. Those analyses will be found in the fuel performance and safety analysis reports to be submitted and reviewed.

BAW-10231P-A, Revision 1

COPERNIC is the fuel rod design code to be used to evaluate fuel rod thermal-mechanical performance. The NuScale fuel will be operated at pressure, flow, and heat flux conditions that are lower than a typical PWR. The staff confirmed that the planned NuScale fuel operation is bounded by the COPERNIC range of application for the required analyses. The one exception noted is that the COPERNIC analysis will not be used for LOCA initialization in NuScale fuel and is not part of the staff applicability analysis. We plan to review this rationale and the comparative analysis to justify the proposed approach for LOCA analyses.

The effect of lower core flowrate on corrosion and corrosion product build-up on fuel rods was noted. The NuScale fuel design has similar limits on fouling for fuel rods as a current PWR with AREVA fuel. A surveillance program is planned and this is to be used for spent fuel rod examination for the first few cycles to confirm that the required limits are being met.

EMF-92-116(P)(A), Revision 0

The staff found that the NuScale fuel assembly design was within the range of applicability with those considered in this topical report for generic mechanical design criteria. The staff observed that the empirical growth models due to radiation exposure may be potentially impacted by the hold-down force, hydraulic lift-force, and temperature. They noted that, while the NuScale topical report does not include the detailed surveillance program, such a program is planned and would be described in the Design Certification Document.

XN-75-32(P)(A), Supplements 1-4

This topical report proposes a methodology to evaluate fuel rod bowing and associated limits. Fuel rod bowing affects the local fuel-water heat transfer. The NuScale fuel bundle geometry is similar to standard AREVA fuel except the spacer grid span length is slightly shorter. Given this geometry and the lower fuel burnup, bowing should be less for the NuScale design. The staff found this methodology acceptable for performing fuel rod bowing analysis.

SUMMARY

The AREVA methods and codes discussed in the NuScale topical report TR-0116-20825, with the noted modifications and staff-imposed limitation, are applicable for use in analyzing the NuScale fuel design. The safety evaluation report should be issued.

Dr. Peter Riccardella did not participate in the Committee's deliberations regarding this matter.

Sincerely,

/RA/

Dennis C. Bley
Chairman

REFERENCES

1. U.S. Nuclear Regulatory Commission, "Safety Evaluation for Topical Report TR-0116-20825, 'Applicability of AREVA Fuel Methodology for the NuScale Design'," Draft, August 17, 2017 (ML17205A147).

2. NuScale Power, LLC, TR-0116-20825-P, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1, July 1, 2016 (ML16187A016).

3. NuScale Power, LLC, TR-0816-51127-P, "NuFuel-HTP2 Fuel and Control Rod Assembly Designs," Revision 1, January 2017 (ML17007A000).

4. NuScale Power, LLC, NuScale Standard Plant Design Certification Application, Chapter 4, "Reactor," Revision 0, February 8, 2017 (ML17013A274).

5. U.S. Nuclear Regulatory Commission, "Acknowledgement of NuScale Power, LLC Request for Suspension of Acceptance Review of Topical Report TR-0116- 20825, 'Applicability of AREVA Fuel Methodology for NuScale Design,' Revision 0," July 7, 2016 (ML16168A423).

6. NuScale Power, LLC, “NuScale Response to NRC Request for Additional Information Letter No. 12 for TR-0116-20825, ‘Applicability of AREVA Fuel Methodology for the NuScale Design’,” Revision 1, March 13, 2017 (ML17068A188).

7. B&W Fuel Company, BAW-10084P-A, “Program to Determine In-Reactor Performance of BWFC Creep Collapse,” Revision 3, July 1995 (ML14191B170).

8. Framatome Cogema Fuels, BAW-10227P-A, “Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel,” Revision 1, June 2003 (ML15162B052).

9. Framatome ANP, BAW-10231P-A, “COPERNIC Fuel Rod Design Computer Code,” Revision 1, January 2004 (ML042930233).

10. Siemens Power Corporation, EMF-92-116(P)(A), “Generic Mechanical Design Criteria for PWR Fuel Designs,” Revision 0, February 1999 (ML003681168).

11. Exxon Nuclear Company, XN-75-32(P)(A), “Computational Procedure for Evaluating Fuel Rod Bowing,” Supplements 1-4, October 1983 (ML081710709).

6. NuScale Power, LLC, “NuScale Response to NRC Request for Additional Information Letter No. 12 for TR-0116-20825, ‘Applicability of AREVA Fuel Methodology for the NuScale Design’,” Revision 1, March 13, 2017 (ML17068A188).

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11. Exxon Nuclear Company, XN-75-32(P)(A), “Computational Procedure for Evaluating Fuel Rod Bowing,” Supplements 1-4, October 1983 (ML081710709).

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